EXHIBIT A

1. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

bypass means for conducting oxygen outside of the flame chamber to the outlet opening of the flame chamber,

an oxygen-supply housing including chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block, the base wall being formed to include first aperture means for discharging oxygen from the chamber means into the flame chamber and second aperture means for discharging oxygen from the chamber means into the bypass means, said first and second aperture means metering the supply of oxygen passing therethrough, and

means for discharging fuel into the flame chamber formed in the burner block, the discharging means including a nozzle extending through the chamber means and the first aperture means formed in the base wall and supported by the base wall to discharge fuel into the flame chamber.

2. The burner assembly of claim 1, wherein the oxygen-supply housing includes a hollow shell appended to the base wall to define the chamber means therebetween.

3. The burner assembly of claim 1, wherein the burner block is formed to include at least one oxygen-admission port lying adjacent to the base wall and communicating with the second aperture means and the bypass means is coupled to the oxygen-admission port and arranged to pass through the burner block to conduct oxygen from the chamber means through the burner block to the outlet opening of the flame chamber.

4. The burner assembly of claim 3, wherein the oxygen-supply housing further includes a frame located between the base wall and the burner block and coupled to the burner block and fastening means for connecting the base wall to the frame and the frame is formed to include at least one oxygen-conducting channel interconnecting the second aperture means and the bypass means in fluid communication.

5. The burner assembly of claim 4, wherein the second aperture means includes a plurality of wall apertures formed in the base wall and the burner block is formed to include an oxygen-admission port communicating with each wall aperture through one of the oxygen-conducting channels.

6. The burner assembly of claim 3, wherein the second aperture means includes a plurality of wall apertures formed in the base wall and the burner block is formed to include an oxygen-admission port communicating with each wall aperture.

7. The burner assembly of claim 6, further comprising frame means for supporting the burner block, the base wall being mounted on the frame means, and the frame means being formed to include oxygen-conducting channels interconnecting the wall apertures formed in the base wall and the oxygen-admission ports formed in the burner block.

8. The burner assembly of claim 1, wherein the nozzle is one of a gas-fuel nozzle and an oil-fuel nozzle.

9. The burner assembly of claim 1, wherein the chamber means formed in the oxygen-supply housing contains only the nozzle.

10. The burner assembly of claim 1, wherein only the nozzle passes through the first aperture means formed in the base wall.

11. The burner assembly of claim 1, wherein the base wall is rectangular, the first aperture means includes a first-stage aperture formed in a center portion of the rectangular base wall, and the second aperture means includes a second-stage aperture formed in each of four corner portions of the base wall and coupled to the bypass means.

12. The burner assembly of claim 1, wherein the discharging means further includes a removable collar engaging the nozzle and threadedly engaging the oxygen-supply housing.

13. The burner assembly of claim 12, wherein the oxygen-supply housing includes an annular lip defining a cylindrical nozzle aperture receiving the nozzle and the removable collar includes an annular side wall surrounding and engaging the annular lip.

14. The burner assembly of claim 1, wherein the first aperture means includes a first-stage aperture formed in the base wall, the second aperture means includes at least one second-stage aperture formed in the base wall and arranged to lie in spaced-apart relation to the first-stage aperture, the bypass means includes at least one oxygen-conducting passageway formed in the burner block and arranged to receive oxygen conducted through a corresponding second-stage aperture, and the internal diameter of each second-stage aperture formed in the base wall is less than the internal diameter of a corresponding oxygen-conducting passageway formed in the burner block to regulate flow of oxygen through the oxygen-conducting passageways formed in the burner block.

15. The burner assembly of claim 14, where the base wall is rectangular, the first-stage aperture is formed in a center portion of the rectangular base wall, and a second-stage aperture is formed in each of four corner portions of the rectangular base wall.

16. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

bypass means for conducting oxygen outside of the flame chamber to the outlet opening of the flame chamber,

means for discharging fuel into the flame chamber formed in the burner block, [and]

an oxygen-supply housing including chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block, the base wall being formed to include first aperture means for discharging oxygen from the chamber means into the flame chamber and second aperture means for discharging oxygen from the chamber means into the bypass means, <u>said first and second aperture means metering the supply of oxygen passing therethrough</u>, the oxygen-supply housing including a hollow shell appended to the base wall to define the chamber means therebetween, wherein the hollow shell has a pyramidal shape and includes at least one triangular

side wall appended to the base wall and formed to include an oxygen-admission port, and wherein the means for discharging fuel extends through the base wall.

17. The burner assembly of claim 16, wherein the chamber means formed in the oxygen-supply housing contains only the nozzle.

18. The burner assembly of claim 16, wherein only the nozzle passes through the first aperture means formed in the base wall.

19. The burner assembly of claim 16, wherein the hollow shell includes a tip and four triangular side walls diverging from the tip toward the base wall.

20. The burner assembly of claim 16, wherein the base wall is rectangular, the first aperture means includes a first-stage aperture formed in a center portion of the rectangular base wall, and the second aperture means includes a second-stage aperture formed in each of four corner portions of the base wall and coupled to the bypass means.

21. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

bypass means for conducting oxygen outside of the flame chamber to the outlet opening of the flame chamber, means for discharging fuel into the flame chamber formed in the burner block, and

an oxygen-supply housing including chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block, the base wall being formed to include first aperture means for discharging oxygen from the chamber means into the flame chamber and second aperture means for discharging oxygen from the chamber means into the bypass means, said first and second aperture means metering the supply of oxygen passing therethrough the oxygen-supply housing including a hollow shell appended to the base wall to define the chamber means therebetween, wherein the hollow shell includes a tip and a side wall extending between the tip and the base wall, the tip is formed to include an aperture, and the discharging means includes a nozzle supported by the base wall and extending through the aperture formed in the tip and the first aperture means formed in the base wall and terminating in the inlet opening of the flame chamber.

22. The burner of claim 21, wherein the nozzle includes a fuel-discharge head, a mounting fixture, and means for metering oxygen flow, and the tip of the hollow shell is formed to include means for supporting the mounting fixture to position the fuel-discharge head in the inlet opening and the metering means at an interface between the first aperture means and the inlet opening to regulate oxygen flowing into the inlet opening and mixing with fuel discharged by the fuel-discharge head.

23. The burner assembly of claim 21, wherein the second aperture means includes a plurality of apertures formed in the base wall and each aperture is arranged to lie in radially spaced-apart relation to a portion of the nozzle extending through the first aperture means.

24. The burner assembly of claim 21, wherein the oxygen-supply housing further includes modular fastening means for selectively connecting the base wall to the burner block so that the oxygen-supply housing and the nozzle are joined together to form a modular unit containing the first and second aperture means that is removable from the burner block at the option of a user.

25. The burner assembly of claim 21, wherein the chamber means formed in the oxygen-supply housing contains only the nozzle.

26. The burner assembly of claim 25, wherein the frame is formed to include one oxygen-conducting channel for each of the apertures formed in the base wall and included in the second aperture means.

27. The burner assembly of claim 21, wherein the base wall is rectangular, the first aperture means includes a first-stage aperture formed in a center portion of the rectangular base wall, and the second aperture means includes a second-stage aperture formed in each of four corner portions of the base wall and coupled to the bypass means.

28. The burner assembly of claim 21, wherein discharging means further includes a removable collar engaging the tip of the hollow shell and the nozzle to retain the nozzle in a fixed position in the chamber means.

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34. [The burner assembly of claim 29,] A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

bypass means for conducting oxygen outside of the flame chamber to the outlet opening of the flame chamber,

means for discharging fuel into the flame chamber formed in the burner block,

an oxygen-supply housing including a chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block, the base wall being formed to include first aperture means for discharging oxygen from the chamber means into the flame chamber and second aperture means for discharging oxygen from the chamber means into the bypass means, said first and second aperture means metering the supply of oxygen passing therethrough, and with the oxygen-supply housing further including a hollow shell appended to the base wall to define the chamber means therebetween the modular fastening means for selectively connecting the base wall to the burner block to position the first aperture means in confronting relation to the inlet opening of the flame chamber so that the oxygen-supply housing can be disconnected from the burner block during rehabilitation of the burner assembly, the modular fastening means including a frame positioned to lie between the base wall and the burner block, means for coupling the frame to the burner block, the fasteners interconnecting the base wall and the frame, and

wherein the burner block is formed to include a plurality of oxygen-conducting passageways defining the bypass means and an annular channel surrounding the inlet opening of the flame chamber and interconnecting each of the oxygen-conducting passageways, the frame includes means for covering the annular channel to define a circular oxygen-conducting passageway between the frame and the burner block and at least one oxygen-conducting channel interconnecting the second aperture means formed in the base wall and the circular oxygen-conducting passageway.

35. The burner assembly of claim 34, wherein the oxygen-conducting passageways formed in the burner block have an arcuate shape and terminate in annular openings formed in the burner block and arranged to lie around the outlet opening of the flame chamber formed in the burner block.

36. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

bypass means for conducting oxygen outside of the flame chamber to the outlet opening of the flame chamber,

means for discharging fuel into the flame chamber formed in the burner block,

an oxygen-supply housing including a chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block, the base wall being formed to include first aperture means for discharging oxygen from the chamber means into the flame chamber and second aperture means for discharging oxygen from the chamber means into the bypass means, said first and second aperture means metering the supply of oxygen passing therethrough, the burner block being formed to include at least one oxygen-admission port lying adjacent to the base wall and communicating with the second aperture means and the bypass means being coupled to the oxygen- admission port and arranged to pass through the burner block to conduct oxygen from the chamber means through the burner block to the outlet opening of the flame chamber, the second aperture means including a plurality of wall apertures formed in the base wall, the burner block being formed to include an oxygen-admission port communicating with each wall aperture, and frame means for supporting the burner block, the base wall being mounted on the frame means, the burner block being formed to include an annular channel around the inlet opening of the flame chamber, the frame means including means for covering the annular channel to define an annular oxygen-conducting passageway therein and means for communicating oxygen discharged from the chamber means through the wall apertures to the annular oxygen-conducing passageway for delivery to the outlet opening of the flame chamber through the bypass means, and wherein the means for discharging fuel is supported by the base wall.

37. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

bypass means for conducting oxygen outside of the flame chamber to the outlet opening of the flame chamber,

means for discharging fuel into the flame chamber formed in the burner block, and

an oxygen-supply housing including chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block, the base wall being formed to include first aperture means for discharging oxygen from the chamber means into the flame chamber and second aperture means for discharging oxygen from the chamber means into the bypass means, said first and second aperture means metering the supply of oxygen passing therethrough, the discharging

means including a fuel discharge nozzle and means for fixing the fuel discharge nozzle in the inlet opening, the fixing means being positioned to lie between the base wall and the burner block, the fixing means being formed to include third aperture means for conducting oxygen discharged through the first aperture means into the flame chamber, the third aperture means defining a first-stage oxygen port having a first effective cross-sectional area and communicating oxygen from the chamber means into the flame chamber, the second aperture means defining a second-stage oxygen port having a second effective cross-sectional area less than the first effective cross-sectional area and communicating oxygen from the chamber means to the outlet opening of the flame chamber through the bypass means.

38. The burner assembly of claim **37**, wherein the third aperture means includes a flange appended to the fuel discharge nozzle and formed to include the first-stage oxygen port and the second aperture means includes a plurality of apertures formed in the base wall collectively to define the second-stage oxygen port.

39. The burner assembly of claim **38**, wherein the flange is ring-shaped and is formed to include a plurality of apertures lying around the fuel-discharge nozzle and defining the first-stage oxygen port and each of the apertures formed in the base wall lies in radially spaced-apart relation to the fuel-discharge nozzle.

40. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

a nozzle including means for discharging fuel into the flame chamber formed in the burner block,

means for fixing the nozzle adjacent to the burner block to position the discharging means at the inlet opening of the flame chamber so that a primary combustion zone is established in the flame chamber between the inlet and outlet openings,

means for supplying oxygen to the flame chamber through the inlet opening so that the oxygen supplied by the supplying means mixes with the fuel discharged by the nozzle in a first-stage region inside the flame chamber to produce a combustible mixture that can be ignited in the primary combustion zone to define a flame having a root portion in the flame chamber and a tip portion outside the flame chamber,

first-stage metering means for metering the flow rate of oxygen from the supplying means into the flame chamber through the inlet opening, the first-stage metering means being appended to the nozzle,

bypass means for delivering oxygen from the supplying means into a downstream second-stage region containing a portion of the flame and lying outside the flame chamber to supplement oxygen supplied to the first-stage region inside the flame chamber by the supplying means, and

second-stage metering means for metering the flow rate of oxygen from the supplying means into the bypass means so that the downstream second-stage region outside the flame chamber through the bypass means is fixed in proportion to the flow rate of oxygen passing through the first-stage metering means.

41. The burner assembly of claim 40, wherein fixing means includes a ring-shaped flange positioned to lie around the nozzle and formed to include at least one oxygen-flow aperture defining the first-stage metering means.

42. The burner assembly of claim 41, wherein the supplying means includes an oxygen-supply housing including chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block and the fixing means further includes a support fixture coupled to the base wall and the ring-shaped flange.

43. The burner assembly of claim 42 wherein the support fixture includes a mounting flange fixed between the base wall and the burner block and a nose portion formed to include a central aperture and the ring-shaped flange is positioned to lie in the central aperture and is coupled to the nose portion to support the nozzle in the inlet opening of the flame chamber.

44. The burner assembly of claim 40, wherein the supplying means includes an oxygen-supply housing including chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block, the fixing means includes a support fixture having a mounting flange fixed between the base wall and the burner block and a nose portion, the nose portion being formed to include a central opening receiving the nozzle, and the first-stage metering means includes a partition positioned to lie between the nozzle and the nose portion and formed to include the at least one oxygen-flow aperture.

45. The burner assembly of claim 44, wherein the partition is a ring-shaped flange surrounding the nozzle.

46. The burner assembly of claim 44, wherein the partition is positioned to lie in the central aperture of the nose portion.

47. The burner assembly of claim 40, wherein the supplying means includes an oxygen-supply housing including chamber means for receiving a supply of oxygen and a base wall adjacent to the burner block and the second-stage metering means includes at least one aperture formed in the base wall and arranged to interconnect to chamber means and the bypass means in fluid communication.

48. The burner assembly of claim 47, wherein the oxygen-supply housing includes a hollow shell appended to the base wall to define the chamber means therebetween.

49. The burner assembly of claim 48, wherein the base wall is formed to include first aperture means for discharging oxygen from the chamber means to the first-stage metering means, the hollow shell includes a tip and a side wall extending between the tip and the base wall, the tip is formed to include an aperture, the nozzle is mounted to extend through the aperture formed in the tip and the first aperture means formed in the base wall and to terminate in the outlet opening of the flame chamber, and the first-stage metering means includes a flow-metering ring appended to the nozzle and formed to include at least one oxygen-flow aperture.

50. The burner assembly of claim 40, wherein the nozzle includes a fuel-discharge head and a mounting fixture, the first-stage metering means is appended to the fuel-discharge head, the supplying means includes an oxygen-supply housing and the fixing means includes first support means for supporting the mounting fixture to position the fuel-discharge head in the inlet opening and second support means for supporting the first-stage metering means in a location between the oxygen-supply housing and the inlet opening.

51. The burner assembly of claim 50, wherein the supplying means includes an oxygen-supply housing including a hollow shell formed to include an aperture receiving the mounting fixture of the nozzle and the first support means includes a collar engaging the hollow shell to retain the mounting fixture in the aperture.

52. The burner assembly of claim 50, wherein the second support means includes a mounting flange fixed between the base wall and the burner block and a nose portion formed to include a central aperture receiving the fuel-discharge head.

53. The burner assembly of claim 50, wherein the first-stage metering means includes a ring positioned to lie around the fuel-discharge head and formed to include at least one oxygen-flow aperture.

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113. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

an oxygen-supply housing defining an oxygen chamber configured to receive a supply of oxygen and a base wall positioned to lie adjacent to the burner block, the base wall being formed to include an aperture positioned to lie in alignment with the inlet opening and to pass oxygen from the oxygen chamber into the flame chamber,

a fuel-discharge nozzle configured to discharge fuel,

a removable collar engaging the oxygen-supply housing and the fuel-discharge nozzle, the collar being formed to support the fuel-discharge nozzle within the inlet opening of the burner block to discharge fuel into the flame chamber formed in the burner block,

wherein the removable collar engages the fuel-discharge nozzle and threadedly engages the oxygen-supply housing, and

wherein the oxygen-supply housing includes an annular lip defining a cylindrical nozzle aperture receiving the nozzle and the removable collar includes an annular side wall surrounding and engaging the annular lip.

114. The burner assembly of claim 113, wherein the oxygen-supply housing includes a hollow shell that has a tip positioned to lie spaced apart from base wall and the removable collar engages the tip of the hollow shell and the fuel-discharge nozzle to retain the fuel-discharge nozzle in a fixed position within the hollow shell.

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116. The burner assembly of claim 113, wherein the fuel-discharge nozzle includes a mounting fixture that selectively engages the collar and the fuel-discharge nozzle is removable from the oxygen-supply housing when the removable collar is disengaged from the mounting fixture.

117. The burner assembly of claim 116, wherein the fuel-discharge nozzle includes an inlet body portion, a central body portion, and a burner tip portion positioned to lie within the inlet opening of the burner block when the removable collar engages the mounting fixture and the oxygen-supply housing is in an installed position.

118. The burner assembly of claim 117, wherein the mounting fixture includes an outer end formed for engagement with the collar, an inner end facing the burner block, and a lip positioned to lie between the outer and inner ends and formed for engagement with the oxygen-supply housing when the collar is in the installed position.

119. The burner assembly of claim 116, wherein the mounting fixture includes an outer end formed for engagement with the collar, an inner end facing the burner block, and a lip positioned to lie between the outer and inner ends and formed for engagement with the oxygen-supply housing when the collar is in the installed position.

120. The burner assembly of claim 116, wherein the inlet opening of the burner block is defined by a wall and the burner tip portion is positioned to lie spaced-apart from the wall of the burner block when the collar is in the installed position.

121. A burner assembly for combining oxygen and fuel to produce a flame, the burner assembly comprising

a burner block formed to include a flame chamber having an inlet opening and an outlet opening,

an oxygen conductor conduit configured to conduct oxygen outside of the flame chamber to the outlet opening of the flame chamber,

an oxygen-supply housing defining an oxygen chamber configured to receive a supply of oxygen and a base wall positioned to lie adjacent to the burner block, the base wall being formed to include a first-stage aperture in alignment with the inlet opening to pass oxygen from the oxygen chamber into the flame chamber and a second-stage aperture arranged to lie in spaced-apart relation to the first-stage aperture to pass oxygen from the oxygen chamber into the oxygen conductor conduit,

a fuel-discharge nozzle extending the oxygen chamber and the first-stage aperture formed in the base wall to discharge fuel into the flame chamber,

further comprising a removable collar engaging the fuel-discharge nozzle and threadedly engaging the oxygen-supply housing, and

wherein the oxygen-supply housing includes an annular lip defining a cylindrical nozzle aperture receiving the fuel-discharge nozzle and the removable collar includes an annular side wall surrounding and engaging the annular lip.

122. The burner assembly of claim 121, wherein first-stage aperture is formed in the base wall, the second-stage aperture is formed in the base wall and arranged to lie in spaced-apart relation to the first-stage aperture, the oxygen conductor conduit includes at least one oxygen-conducting passageway formed in the burner block and arranged to receive oxygen conducted through a corresponding second-stage aperture, and the internal diameter of each second-stage aperture formed in the base wall is less than the internal diameter of a corresponding oxygen-conducting passageway formed in the burner block to regulate flow of oxygen through the oxygen-conducting passageways formed in the burner block.